Evaluation of the GeoCloud Integrated Geographic Information System in the Province of Pangasinan

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Abstract *– The study aimed to evaluate a Geographic Information System (GIS) called GeoCloud Integrated GIS from Japan in the Province of Pangasinan in the context of disaster preparedness. The respondents of the study were the trained and only GeoCloud users in the Province. Descriptive method of research was used in the form of questionnaire to gather data. Frequency and Percentage were used to analyze the acquired data and ISO 9126 was used as the criteria for system software evaluation. It found out that GeoCloud Users were generally young in age and service, a balance of male and female, rank and file employees yet educated and DRRM trained. GeoCloud was found of good quality based on the criteria. However, users expressed a problem regarding computer lags in loading bulk maps. Based from the results, the study recommended the utilization of higher computer processors to minimize lags and achieve optimum performance for disaster preparedness.*

Keywords *–DRRM, Disaster Preapredness, GIS, GeoCloud*

INTRODUCTION

Geographic Information System (GIS) is one of the greatest epiphanies of modern day technology aiding Disaster Risk Reduction and Management (DRRM). GIS, as a computer software which systematically organizes and presents earth's surface data, has been of great help to disaster managers across the globe especially in making major decisions before, during and after disaster events [1]. Through its systematic presentation of analyzed data represented graphically and visually by digital maps, the risk of disaster is reduced and more lives and properties are saved.

In 2016, Japan, represented by the Japan International Cooperation Agency (JICA), in partnership with Japan private Sectors Informatix and CTII Engineering granted a first-in-the-country project entitled 'A Verification Survey to disseminate Japanese Technology for Integrated Geographic Information System (GIS) for Advancement of Regional Disaster Prevention," or also known as the "GeoCloud Project." It was piloted in the province of Pangasinan where the Provincial Government, municipalities of Lingayen and Binmaley and the city of Dagupan were the recipients. A GIS which differentiates itself from other GIS because of its cloud-based function and information sharing capacity, GeoCloud Integrated GIS aimed to improve the disaster preparedness of the province thus enhancing its capacity to face threats of disasters [2].

It is in this view point that this work is directed.

The researcher seeks to know whether the GeoCloud Integrated GIS is a system that can really benefit the province in disaster management or not; he seeks to unearth the quality of the system so as to be recommended to other local government units not only in the province, but also in the whole country to be utilized for disaster management.

OBJECTIVES OF THE STUDY

The study seeks to answer the following questions; (1) the profile of the respondents (in this case the GeoCloud users in the Province of Pangasinan themselves) in terms of their age, sex, highest educational background, position in the office, years of service and the number of trainings attended related to Disaster Risk Reduction and Management, (2) the quality of the GeoCloud Integrated Geographic Information System based from the ISO 9126 presented as follows; (a) Functionality which has the

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sub-characteristics of suitability, accurateness, interoperability, compliance and security (b) Reliability which has the sub-characteristics of maturity, fault tolerance, recoverability (c) Usability which has the sub-characteristics of understandability, learnability and operability (d) Efficiency which has the sub-characteristics of Time behavior and Resource behavior (e) Maintainability which has the sub-characteristics of analyzability, changeability, stability and testability (f) Portability which has the sub-characteristics of adaptability, installability, conformance and replaceability [3] and (3) The problems encountered in using the GeoCloud Integrated Geographic Information System based from the day-to-day usage.

Profiles		Frequency	Percentage
Age	**21-25**	**8**	**40.0**
	26-30	**8**	**40.0**
	31-35	1	5.0
	36-40	1	5.0
	41-45	2	10.0
	Total	20	100.0
Sex	**Male**	**10**	**50.0**
	Female	**10**	**50.0**
	Total	20	100.0
Highest Educational Attainment	**College Graduate**	**20**	**100.0**
Position	**Rank and File**	**19**	**95.0**
	Managerial	1	5.0
	Total	20	100.0
Years of Service	**1-5**	**16**	**80.0**
	6-10	3	15.0
	11-15	1	5.0
	Total	20	100.0
Significant Trainings Attended	0.00	6	30.0
	1.00	5	25.0
	2.00	**6**	**30.0**
	3.00	2	10.0
	4.00	1	5.0
	Total	20	100.0

The scope of the study does not include other uses of GIS except for DRRM specifically in the aspect of disaster preparedness.

MATERIALS AND METHODS

The study used descriptive type of research through questionnaires in order to gather data. Respondents of the study were the 20 trained and only GeoCloud Users in Pangasinan. Hence, the questionnaires were divided into three parts corresponding to the 3 problems raised in the study. The first part asked the profile of the respondents.

Table 1. Likert Scale

Literal Rating	Weighted Mean Score	Descriptive Interpretation
5	**4.51-5.00**	**Excellent**
4-	**3.51-4.50**	**Good**
3	**2.51-3.50**	**Average**
2	**1.51-2.50**	**Poor**
1	**1.00-1.50**	**Very Poor**

The second part asked the quality of the system based on the criteria laid down by ISO 9126. Likert scale was used to measure quantitatively the results.

Finally, the last part asked the problems encountered with the system. Generally, frequencies and percentages were also used to analyzed the data and produce the results of the study.

RESULTS AND DISCUSSION

The results of the study simply answered the 3 main problems presented. However, the results were logically presented by the researcher substantiated by scientific studies and other relevant information.

Table 2. Profile of the Respondents

As to age, the study revealed that 80% of the system users are from ages 21-30. The first 40% are ages 21-25 and other 40% are ages 25-30. This suggested that users belong to the younger group of government employees because of their computer literacy. As to sex, the study showed that respondents were 50% male and 50% female. This suggested that since the system was being utilized for DRRM, gender sensitivity was considered. As to Highest Educational Attainment, the study revealed that 100% of the users were college graduate. This suggested that system users were educated and that their computer literacy was attributed to this. As to Position, 95% of the

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system users were in the rank and file position. This Suggested that system users were on the skill/planning part of DRRM since decision-making part belonged to managerial position.

As to years of Service, 80% of the respondents were from 1-5 years in service. The reason for this was probably because utilizing the system was entrusted to the younger employees who were more computer literate than those who were ahead of them. Finally, as to Significant trainings attended related to DRRM**,** the study showed that 30% of the system users have at least 2 trainings related to DRRM. 25% have at least 1 training while 10% have 3 trainings and 5% have 4. However, 30% have no DRRM training. Certain government protocols were considered that was why system users' trainings on DRRM were quite limited.

Table 3. Evaluation Results

ISO 9126 (Evaluation Criteria)	**Sub-characteristics**	**Statistical Results (over-all mean)**	**Likert Scale**
Functionality	Suitability Accurateness Interoperability Compliance Security	4.27	Good
Reliability	Maturity Fault tolerance Recoverability	3.63	Good
Usability	Understandability Learnability Operability	4.47	Good
Efficiency	Time behavior Resource behavior	4.28	Good
Maintainability	Analyzability Changeability Stability Testability	3.6	Good
Portability	Adaptability Installability Conformance Replaceability	4.2	Good

As to Functionality, the study showed that the result of the over-all mean which was 4.27 when reflected on the Likert scale was indeed good. This was so because its keys and function operate conveniently. Geographic Information Systems for Disaster Management supports this result since basically every GIS can function or can be used for disaster management [4].

As to Reliability, the study revealed that the evaluation was good. Its overall mean which was 3.63 reflected that respondents found the system reliable. Mazumar and Paul's [5] work proved GIS reliability because they were able to identify vulnerable areas in India. This work however is reliable both in the sense that it has the function to identify vulnerable areas and that the data processed through this system can be backed up.

The study showed that as regards the system usability, the overall evaluation is good as reflected on the Likert scale based from the overall mean 4.47. Zakariaa et al., [6] also supported the usability of GIS since their study claimed that 700 people were able to utilize GIS in just seven weeks. Hence, in the same way, GeoCloud Integrated GIS is also usable because it can be understood, learned and operated with ease.

Also, the study showed that in terms of the system's efficiency, the over-all mean 4.28 is reflected good. Holdstock's work also asserted that good GIS is indeed efficient and problems only arise as regards efficiency when there is an absence of GIS utilization plan. [7] As such, the result of this study reflects his claim in the sense that it is only when GIS utilization planning is absent that it can be inefficient.

The system's maintainability was revealed to be also good based from the table 3.6. In comparison to Donnelly [8], in his study of Free and Open Source GIS, GeoCloud Integrated GIS is much more

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maintainable. This has something to do with licensing component. GIS which have license are more stable. Since GeoCloud Integrated GIS has license, it is more stable hence maintainable.

Finally, the study revealed that the system's portability is rated good by the respondents. The over-all mean 4.2 meant that the respondents believed the system is indeed portable. This was anchored on the system's feature of cloud-based where as long as a computer was connected to the GeoCloud Server it could access the system. Evangelidis., et al [9] work on cloud-based GIS supports the result of this study in terms of portability. Both solve the problem of environmental management of GIS systems where working environment can be easily handled because of portability.

Table 4. Problems with the System

Problems Encountered	Frequency	Percent	Rank
Experience of lags in loading bulk maps	18	90.0	1
Disconnects from server	14	70.0	2
Unstable network connection	12	60.0	3.5
Only one open street map design	12	60.0	3.5
Complex loading of data especially with other types of georeferencing methods.	11	55.0	5
Complicated printing hazard maps with legend and annotation	7	35.0	6
Additional Functions needed	6	30.0	7.5
Complicated hazard map analysis	6	30.0	7.5
Complex loading of data access through the cloud	5	25.0	9.5
Complex Data sorting in the cloud	5	25.0	9.5

The study showed that 90% of the respondents experienced lags in loading bulk maps. It ranked as the number 1 problem of the system. These lags were attributed not to the system itself but to the hardware component. Also, 70% of the respondents agreed that they experience disconnection from server. This was attributed to the network latency experienced in network connection and not to the system itself.

60% of the respondents expressed that the network connection of the system is unstable. The same explanation as in the problem with disconnection from server (stated above) can be applied. Likewise, 60% of the respondents expressed that they have a problem with only one street map design for the system. This was not because the system cannot load other open street maps. It was because the system was so because it posted a challenge to the users to fill the seemingly uncompleted open street map with vital information for DRRM. 55% of the respondents agreed that they experienced complexity in loading data especially with other types of georeferencing methods. But since the system was built for global market, it could load other types of georeferencing methods—with ease—only that this function still needed to be taught to the users.

In addition, only 35% of the respondents agreed that printing hazard maps with legend and annotation was complicated. Printing hazard maps in GeoCloud system automatically integrated map legends and annotation in the desired output. And so, only 30% of the respondents agreed that there is a need for additional function. Functions were already enough to achieve the objectives of the system.

Only 30% of the respondents agreed that there is complexity in hazard map analysis. This is so because the system could present analysis in the maps being overlaid with ease. And, only 25% of the respondents agreed that loading data accessed through the cloud was complex. This can be attributed to the easy drag and drop function of the system. Finally, only 25% of the respondents agreed that there was complexity in data sorting in the cloud. This was so because GeoCloud could arrange and present data automatically and systematically.

CONCLUSION AND RECOMMENDATION

The study concludes that GeoCloud Integrated GIS users are generally young. Since they are young, their career in the government service is young as well. They are a balanced of male and female who are college graduates (who have been skilled with basic computer knowledge) and therefore could operate the

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system with ease. Also, users are generally in the rank and file positions yet trained for Disaster Risk Reduction and Management. Hence, the GeoCloud Integrated GIS is functional, reliable, usable, efficient, maintainable and portable. Therefore, the system is of good quality.

Henceforth, majority of the GeoCloud users experienced lags in loading bulk maps. This ranked as the number 1 problem regarding the system. Most users also experienced disconnection from server, unstable network connection, complexity in loading other georeferecing system and have problems with having only one street map design. But then, most users agreed that; there was no need to add additional functions to the system; no complexity in map analysis as well as printing capacities; and no complexity in loading data through the cloud or in its sorting function.

With these, the researcher recommends the following; (1) senior government employees should also try using the system since their experience in DRRM is invaluable and more DRRM trainings should be opened for users, (2) local government units which utilize the system must invest on upgrading their PCs to higher processors so as to really experience GeoCloud in its full potential, at an optimum level. Finally, (3) the system was evaluated good. Therefore, the researcher recommends the system to other Local Government Units to be utilized for DRRM.

REFERENCES

[1] GIS (geographic information system) (n.d.). Retrieved February 11, 2018, from https://www.nationalgeographic.org/encyclopedia/geographic-information-system-gis/

[2] Informatix Inc., (2016). JICA Verification Survey: GeoCloud Integrated GIS Project in Pangasinan.

[3] ISO 9126 Software Quality Characteristics. (n.d.). Retrieved from http://www.sqa.net/iso9126.html.

[4] Tomaszewski, B. (2014). *Geographic information systems (GIS) for disaster management*. CRC Press.

[5] Mazumdar, J., & Paul, S. K. (2018). A spatially explicit method for identification of vulnerable hotspots of Odisha, India from potential cyclones. *International Journal of Disaster Risk Reduction*, *27*, 391-405.

[6] Zakaria, F., Thye, Y. P., Hooijmans, C. M., Garcia, H. A., Spiegel, A. D., & Brdjanovic, D. (2017). User acceptance of the eSOS® Smart Toilet in a temporary settlement in the Philippines. *Water Practice and Technology*, *12*(4), 832-847.

[7] Holdstock, D. A. (Ed.). (2016). *Strategic GIS Planning and Management in Local Government*. CRC Press.

[8] Donnelly, F. P. (2010). Evaluating open source GIS for libraries. *Library Hi Tech*, *28*(1), 131-151.

[9] Evangelidis, K., Ntouros, K., Papatheodorou, K., Konstantinidisa, A., & Perakis, K. (2014). geoClouds for environMental ManageMent. *Journal of Environmental Protection and Ecology*, *15*(2), 623-629.

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